CONTINUING MEDICAL EDUCATION

The Epidemiology, Etiology, Diagnosis, and Treatment of Osteoarthritis of the Knee

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SUMMARY

Background: Osteoarthritis is the most common joint disease of adults worldwide. Its incidence rises with age. Both intrinsic and extrinsic risk factors promote its development. In men aged 60 to 64, the right knee is more commonly affected; in women, the right and left knees are affected with nearly equal frequency.

Methods: The PubMed, Medline, Embase and Cochrane Library databases were selectively searched for current studies (up to September 2009; case reports excluded) on the epidemiology, etiology, diagnosis, staging, and treatment of osteoarthritis of the knee. The search terms were "gonarthrosis," "prevention," "conservative treatment," "joint preservation," "physical activity," "arthroscopy," "osteotomy," "braces," "orthoses," and "osteoarthritis knee joint."

Results and Conclusion: Osteoarthritis is not yet a curable disease, and its pathogenesis remains unclear. The best treatment for osteoarthritis of the knee is prevention. The goal of therapy is to alleviate clinical manifestations. The therapeutic spectrum ranges from physiotherapy and orthopedic aids to pharmacotherapy and surgery.

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Osteoarthritis is the most common disease of joints in adults around the world (1). Felson et al. reported that about one-third of all adults have radiological signs of osteoarthritis, although Andrianakos et al., in an epidemiological study, found clinically significant osteoarthritis of the knee, hand, or hip in only 8.9% of the adult population (2, 3). Knee osteoarthritis was the most common type (6% of all adults). The likelihood of developing osteoarthritis increases with age. Studies have shown that knee osteoarthritis in men aged 60 to 64 is more commonly found in the right knee (23%) than in the left knee (16.3%), while its distribution seems to be more evenly balanced in women (right knee, 24.2%; left knee, 24.7%) (3, 4). The prevalence of osteoarthritis of the knee is higher among 70- to 74-year-olds, rising as high as 40% (e2). When the diagnosis is based on clinical signs and symptoms alone, the prevalence among adults is found to be lower, at 10% (e3). The radiological demonstration of typical signs of osteoarthritis of the knee is not correlated with symptoms: Only about 15% of patients with radiologically demonstrated knee osteoarthritis complain of knee pain (e4). The incidence of the disorder among persons over 70 is estimated at 1% per year (e5).

Epidemiological studies have revealed that there are both endogenous and exogenous risk factors for osteoarthritis *(Table 1)*. Genetic factors unquestionably play a role. In a clinical study involving female twins, Spector et al. showed an effect of heredity on the development of osteoarthritis of the hip and knee (e6). In only very few cases, however, can osteoarthritis be attributed to the effect of a single gene. Its development and progression are more likely due to an interaction among multiple genes, in combination with further risk factors. Cross-sectional studies have shown that the risk of knee osteoarthritis is 1.9 to 13.0 times higher among underground coal miners than in a control population (e7–e9); presumably, the main risk factor in this

Epidemiology

Osteoarthritis is the most common adult joint disease.

occupational group is frequent work in the kneeling or squatting position. Construction workers, too, particularly floorers, have a significantly elevated prevalence of knee osteoarthritis (e10). In another epidemiological study, Grotle et al. found a significant dose-effect relationship for overweight (BMI >30) as a risk factor for knee osteoarthritis, but not for hip osteoarthritis (e11).

The present article will discuss osteoarthritis of the knee on the basis of a selective review of relevant scientific and clinical publications and an intensive evaluation of current data from clinical trials. The information given here should enable the reader to

- recognize the risk factors for osteoarthritis of the knee,
- be familiar with the diagnostic tests used to demonstrate it, and
- know how it can be prevented and what joint-preserving treatment options are available.

Etiology

Knee osteoarthritis is classified as either primary (idiopathic) or secondary. Among the various structures making up the knee joint, the hyaline joint cartilage is the main target of the harmful influences that cause osteoarthritis and the structure in which the disease begins. 95% of hyaline cartilage consists of extracellular matrix. Otte et al. coined the term "organ of articulation" to emphasize the common functional purpose of all structures composing the joint (5), from its bony components covered with hyaline cartilage to its capsule, ligaments, and menisci, and the muscles that move it. A list of etiologies of secondary osteoarthritis of the knee can be found in *Box 1*.

Pathophysiology

The dynamic equilibrium between the continual, ongoing formation and breakdown of the cartilaginous matrix is regulated by an interplay of anabolic influences (e.g., insulin-like growth factors [IGF] I and II) and catabolic influences (e.g., interleukin-1, tumor necrosis factor [TNF] alpha, and proteinases). To a limited extent, these mechanisms can eliminate or compensate for the harmful influences that cause osteoarthritis by stimulating and modifying the metabolic activity of chondrocytes. When these harmful influences exceed the system's ability to compensate, however, matrix degradation occurs; this is the first step in the development of osteoarthritis, which can progress to advanced disease *(Figure 1)*. Why cartilage

TABLE 1

Endogenous and exogenous risk factors for osteoarthritis of the knee[*1]

Endogenous	Exogenous
Age	Macrotrauma
Sex	Repetitive microtrauma
Heredity	Overweight
Ethnic origin (more common in persons of European descent)	Resective joint surgery
Post-menopausal changes	Lifestyle factors (alcohol, tobacco)

[*1]from (e14)

BOX 1

Etiologies of secondary osteoarthritis of the knee*[1]

- Post-traumatic
- Congenital/malformation
- Malposition (varus/valgus)
- Postoperative
- Metabolic
  - Rrickets
  - Hemochromatosis
  - Chondrocalcinosis
  - Ochronosis
- Endocrine disorders
  - Acromegaly
  - Hyperparathyroidism
  - Hyperuricemia
- Aseptic osteonecrosis

[*1]from (e14)

Risk factors

Construction workers, particularly floorers, are at significantly elevated risk for osteoarthritis. Overweight has also been shown to have a significant dose-effect relationship with osteoarthritis.

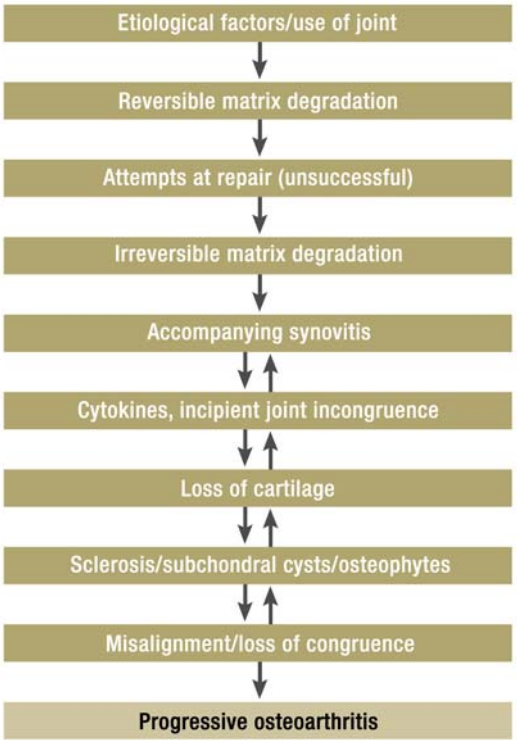
Etiology

Knee osteoarthritis can be primary or secondary. The hyaline cartilage of the knee joint is the target of the damaging influences that cause osteoarthritis.

Figure 1: Plain x-rays of the left knee in Kellgren and Lawrence stage 4: a) AP view, b) lateral view

The pathogenesis of osteoarthritis (modified from e14)

FIGURE 2



degenerates is not yet well understood. Mechanical and enzymatic factors are thought to impair chondrocyte function and damage the matrix (e12, e13) *(Figure 2)*.

Diagnostic evaluation

The main goal of diagnostic evaluation is to demonstrate the presence of osteoarthritis unequivocally, or else to rule it out. A precise diagnosis enables precise treatment. The major elements of the diagnostic evaluation are the history, physical examination, imaging studies, and, in some cases where special questions arise, laboratory testing.

History

Patients suffering from osteoarthritis often complain of pain on movement, typically occurring when movement is initiated or when the patient begins to walk. The pain is often described as a dull ache. As osteoarthritis progresses, the pain becomes continuous, and the functionality of the joint is severely impaired. Historical criteria that are relatively specific for osteoarthritis, but can also be found in other joint diseases, are listed in *Box 2*.

Physical examination

Each stage of the disorder has its own characteristic physical findings. Knee pain is the leading symptom, usually becoming worse when the affected knee is put in motion and improving when it is at rest. Persistent pain at rest, or at night, can be a sign of advanced osteoarthritis. The physical examination should incorporate all relevant findings, including findings on inspection and palpation, testing of the range of movement, and special functional tests when needed (e.g., ligament stability, meniscus tests, gait analysis). The physical examination of the knee ligaments consists of the following:

- testing of the lateral ligaments with varus or valgus stress, and
- testing of the anterior and posterior cruciate ligaments with the drawer test.

Likewise, the menisci should be diagnostically tested manually, and the femoropatellar joint should be assessed for signs of irritation and for normal patellar mobility. In the Zohlen test, the patient's knee is extended, and the examiner gently presses the patella into the trochlear groove while asking the patient to tense the extensor muscles of the thigh (quadriceps femoris). If this maneuver causes pain, the test is

Symptoms and signs

Persons suffering from knee osteoarthritis complain of limited movement and pain when they initiate movement of the knee or start to walk. In advanced disease, they may complain of nocturnal or permanent knee pain.

Physical examination includes:

– Generally relevant data
– Inspection and palpation
– Examination of the range of motion
– Special functional tests (e.g., meniscus tests, gait analysis)

positive. Limping revealed by gait analysis may be due to shortening of one leg.

Imaging studies

X-ray imaging studies are used both for primary diagnosis and to assess the progression of the disease. Plain films should be obtained in standardized fashion in at least two planes (a-p and lateral) *(Figure 1)*. Special functional plain films can be obtained as well to answer specific diagnostic questions. The typical radiological signs of knee osteoarthritis that can be seen on plain films are incorporated in the staging system of Kellgren (6) *(Box 3)*.

Supplementary radiological studies can include MRI, to demonstrate the hyaline cartilage, as well as ^{99m}Tc bone scanning, to assess metabolic activity in the subchondral bone. These tests do not appear to yield much additional useful information. Ultrasonography is a good way to demonstrate the soft tissues and fluid-filled spaces, but it is highly examiner-dependent, and much experience is needed for the proper assessment of its findings.

Staging

The clinical symptoms and signs of osteoarthritis and its radiological correlates follow a typical course as the disease progresses and can thus be incorporated into a clinically useful staging system. The WOMAC osteoarthritis index (7), for example, reflects the clinical severity of the disease. Though not commonly used in routine clinical practice, the WOMAC index permits a valid, reproducible assessment of the degree of impairment by pain and loss of function. A number of different joint-specific scoring systems have been developed (8); they vary with respect to the weighting of subjective and objective criteria.

Treatment

Osteoarthritis is not a curable disease at present, as the mechanism by which it arises and progresses remains incompletely understood. Therefore, the goal of treatment is to alleviate the signs and symptoms of the disease and, if possible, to slow its progression. The therapeutic spectrum ranges from general measures to physiotherapy, orthopedic aids and orthoses, pharmacotherapy, and finally surgery and rehabilitation. As Mohig et al. stated, "The best treatment for knee osteoarthritis is prevention" (e15). Surgery is indicated when the patient's symptoms accord with the physical

BOX 2

Specific historical features of osteoarthritis*[1]

- Pain
  - Pain at the beginning of movement
  - Pain during movement
  - Permanent / nocturnal pain
  - Need for analgesics
- Loss of function
  - Stiffness
  - Limitation of range of movement
  - Impairment in everyday activities
  - Need for orthopedic aids
- Other symptoms
  - Crepitation
  - Elevated sensitivity to cold and/or damp
  - Stepwise progression

*[1]Historical criteria for osteoarthritis in use at the Department of Orthopaedic and Trauma Surgery, University of Cologne

BOX 3

The staging of osteoarthritis of the knee, after Kellgren and Lawrence*[1]

- Stage 0
  - no abnormality
- Stage 1
  - incipient osteoarthritis, beginning of osteophyte formation on eminences
- Stage 2
  - moderate joint space narrowing, moderate subchondral sclerosis
- Stage 3
  - >50% joint space narrowing, rounded femoral condyle, extensive subchondral sclerosis, extensive osteophyte formation
- Stage 4
  - joint destruction, obliterated joint space, subchondral cysts in the tibial head and femoral condyle, subluxed position

[1]from (6)

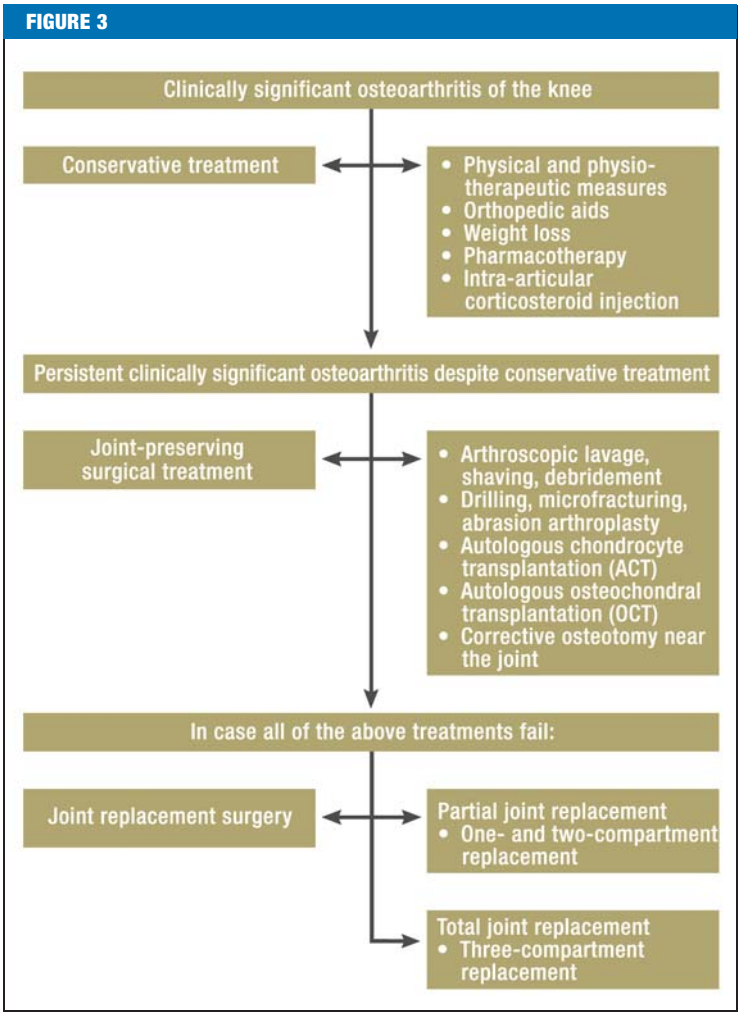
Imaging studies

The typical radiological findings of Kellgren/Lawrence stage 4 knee osteoarthritis are joint space narrowing, subchondral sclerosis, subchondral cysts, and peripheral osteophytes.

Clinical severity

The clinical severity of knee osteoarthritis is reflected in the WOMAC osteoarthritis index, which enables a valid, reproducible assessment of the degree of impairment by pain and loss of function.

FIGURE 3



The treatment algorithm for clinically significant osteoarthritis of the knee in use at the Department of Orthopaedic and Trauma Surgery, University of Cologne

and radiological findings and all conservative treatments have been exhausted. A helpful therapeutic algorithm for osteoarthritis of the knee, which the authors have used successfully at their institution, is shown in *Figure 3*.

Conservative treatment

The conservative treatment of knee osteoarthritis is based on a stepwise therapeutic scheme *(Box 4)*, which is to be applied individually depending on the severity and distribution of symptoms as well as any possible accompanying illnesses (9, e16). A guideline for the treatment of osteoarthritis of the knee (e17) has been issued jointly by the German Society for Orthopedics and Orthopedic Surgery (Deutsche Gesellschaft für Orthopädie und orthopädische Chirurgie) and the German Professional Association of Orthopedists and Trauma Surgeons (Berufsverband der Ärzte für Orthopädie und Traumatologie). The goals of treatment, as stated in the guideline, are:

1. Pain relief
2. Improved quality of life
3. Improved mobility
4. Improved walking
5. Delayed progression of osteoarthritis

The guideline does not contain any assessment of the individual conservative measures mentioned, nor does it contain stage-specific recommendations for conservative treatment. A summary of published studies on the non-pharmacological treatment of knee osteoarthritis, with their results and levels of evidence according to the criteria of evidence-based medicine (CEBM, [e18]), is given in *Table 2*.

An extensive discussion of each type of conservative treatment would be beyond the scope of this article, which is intended to provide an overview of all potentially applicable treatments.

General measures

These include patient education, lifestyle adjustment, and, when indicated, weight loss. Any factors placing excessive and damaging stress on the knee joint should be eliminated, if possible. For example, with regard to sports, the patient might be advised to switch from Alpine (downhill) to Nordic (cross-country) skiing. For any type of sport, good, adequately shock-absorbing shoes are important, as are the proper training equipment and correct performance of the sport. Chodosh et al., in a meta-analysis (evidence level Ia), found that general measures have no appreciable effect on pain

Conservative treatment

Conservative treatment is provided in stepwise fashion, as recommended by the European League Against Rheumatism (EULAR).

General measures:

– Lifestyle adjustment, weight loss if necessary
– Elimination of damaging influences on the knee
– Good, shock-absorbing shoes

and function in knee osteoarthritis (e19). A further meta-analysis of 16 controlled trials (e20) yielded the finding that individual exercise and self-management had a moderate, but clinically significant psychological effect and made a positive contribution to the patients' emotional well-being.

Physiotherapeutic measures

Physiotherapy for knee osteoarthritis includes exercise therapy as well as physical measures, including the following:

- ultrasound application (to relieve pain and support endogenous healing processes)
- electrotherapy
- muscle stimulation
- application of heat and cold
- transverse friction (a special massage technique)
- acupuncture
- stretching/walking
- traction.

Pollard et al. showed that manual therapy reduces pain and improves function significantly, in comparison to a control group (evidence level II) (10). An analysis of 17 randomized controlled trials (evidence level Ia) showed that pain could be relieved, and function improved, by either individualized or group therapy (e20, e21). No particular treatment program was found to yield better results than the others.

Orthopedic aids and orthoses

Sometimes, an orthopedic aid or orthosis is necessary. Orthopedic aids include, among others, cushioned heels (providing a shock-absorbing function) and wedges to elevate the inner or outer side of the shoe, thereby correcting the axis to a certain extent and taking mechanical stress off the affected part of the joint. Some patients initially do not want to accept these aids, but can be made more amenable to them by adequate patient education and the active involvement of orthopedic technicians and shoemakers. Knee orthoses are also intended to relieve pain and improve joint function (11). In a Cochrane Review, five controlled trials (evidence level Ib) were evaluated (e22). Patients wearing an orthosis were found to have significantly less pain and better function than patients in the control groups.

Pharmacotherapy

The following classes of medications are currently used to treat osteoarthritis of the knee:

BOX 4

EULAR stepwise recommendations for the conservative treatment of osteoarthritis of the knee*[1]

1. Optimal management requires a combination of non-pharmacological and pharmacological treatment modalities
2. The treatment of knee osteoarthritis should be tailored according to risk factors, severity of pain, presence or absence of joint effusion, and degree of osteoarthritic damage
3. Non-pharmacological treatment: weight loss, orthopedic aids, physical and physiotherapeutic measures
4. Paracetamol is the analgesic of first choice for long-term use, if effective
5. Topical applications (e.g., non-steroidal anti-inflammatory drugs [NSAID]) are effective

7. Opioid analgesics can be used effectively if paracetamol or NSAID are ineffective or poorly tolerated
8. Symptomatic slow-acting drugs for osteoarthritis (SYSADOA) are an effective symptomatic treatment
9. Intra-articular injection of corticosteroids to treat effusions and severe pain

*[1]modified from (9); EULAR, European League Against Rheumatism

- analgesics/anti-inflammatory agents
- glucocorticoids
- opioids
- symptomatic, slow-acting drugs for osteoarthritis (SYSADOA)
- anti-cytokines.

The specific risks associated with the use of classic non-steroidal anti-inflammatory drugs (NSAIDs) are due to their mechanism of action, i.e., the inhibition of prostaglandin secretion through the inhibition of cyclooxygenase (COX) in one or both of its two isoforms, COX-1 and COX-2. Specific inhibitors of COX-2 have a selective anti-inflammatory effect but are still markedly nephrotoxic. Nonselective COX inhibitors also have renal side effects. The Cochrane database contains a review of 16 randomized trials (evidence level Ia) (e23); yet, despite the large number of studies,

Manual treatment

Manual treatment has been shown to reduce pain and improve function significantly.

Pharmacotherapy:

– Analgesics/anti-inflammatory drugs
– Glucocorticoids
– Opioids
– SYSADOA
– Anti-cytokines

TABLE 2

Non-pharmacological treatment

Type of treatment	Question(s) addressed in clinical trials	Number of trials	Level of evidence	Study findings
Physiotherapy	Evidence for benefit of physiotherapy	17 RCT	Ia	Pain relief, functional improvement
Orthosis	With vs. without orthosis	4 RCT	Ib	Positive effect
Ice treatment	Ice massage, cold compresses	3 trials	Ib	Ice massage: improved flexion and extension Cold compresses: no reduction of pain
Electrical stimulation	TENS vs. no TENS	6 trials	Ia	Pain relief, improved mobility
Ultrasound	Ultrasound vs. placebo, short-wave radiation, or galvanic current	3 trials	Ib	No effect

RCT, randomized controlled trial; TENS, transcutaneous electrical neural stimulation

the efficacy and safety of these drugs cannot yet be judged conclusively.

When signs of inflammation arise, intra-articular glucocorticoid injections can very rapidly eliminate a joint effusion. The most suitable type of glucocorticoid for injection has been found to be one with a long half-life, in crystalloid solution, with a small crystal size (e.g. triamcinolone acetonide or hexacetonide, at a dose of 10 mg or 40 mg, respectively). Steroid injections should be used with caution in diabetic patients who are already hyperglycemic. All joint punctures and injections must be performed with the proper sterile technique, as described in the guidelines. In a meta-analysis (evidence level Ia) of the efficacy of intra-articular corticosteroid injections compared to placebo, hyaluronic acid, and lavage, it was found that corticosteroid injections significantly reduced pain two weeks after the injection (RR 1.81) and three weeks after it (RR 3.11) (e24). The German professional associations have not yet issued any official recommendation about the duration and frequency of intra-articular corticosteroid injections. Their guidelines are currently being updated. On the other hand, the current guidelines of the American Academy of Orthopaedic Surgeons (AAOS) recommend that intra-articular corticosteroid injections for the treatment of osteoarthritis should be performed in the short term only (e25). Septic arthritis is a serious potential complication. In a retrospective study from Iceland, the risk of septic arthritis was calculated to be 0.037% per corticosteroid injection (e26). Thus, in Iceland, the frequency of joint infection complicating intra-articular corticosteroid injection is 1 case per 2633 injections.

In addition to the types of medications mentioned above, there is a heterogeneous group of medications that, unlike the COX-2 inhibitors, do not inhibit prostaglandin synthesis. This group includes hyaluronic acid, D-glucosamine sulphate, chondroitin sulphate, and diacerein. These medications are collectively called slow-acting drugs for osteoarthritis (SADOA), a term coined by the Osteoarthritis Research Society International (OARSI). They can be given either orally or directly into the joint. Their effect, as the term SADOA implies, is of gradual onset. These medications, in turn, are subdivided into symptomatic slow-acting drugs for osteoarthritis (SYSADOA) and the so-called disease-modifying osteoarthritis drugs (DMOAD). The mechanisms of action of the individual agents have not yet been fully elucidated; they range from inhibition of inflammation and nociceptor blockade to a potential alteration of the viscoelastic properties of cartilaginous tissue. Towheed et al. found that these drugs slow the radiological progression of knee osteoarthritis (e27). In a randomized, controlled, double-blind trial, Petrella et al. (12) found that patients with knee osteoarthritis treated with intra-articular injection of hyaluronic acid had significantly less pain and better function for up to three weeks afterward (evidence level I). No severe systemic side effects were reported.

A number of drugs for osteoarthritis are intended to counteract the pro-inflammatory, matrix-destroying effect of cytokines. Further treatment approaches include the administration of antibodies against TNF-α (which are currently available) or the use of anti-inflammatory enzymes such as IL-4, IL-10, IL-13 and TNF-β (13).

For the sake of completeness, mention is also made of other treatment approaches such as ointments, herbal and homeopathic remedies, leeches, and special diets containing gelatin and amino sugars. The efficacy of these treatments seems questionable.

The AAOS guideline

Intra-articular corticosteroid injections are recommended for no more than short-term use.

Further treatment options

– Bone-stimulating treatments
– Joint surface restoration
– Corrective osteotomy near the knee joint

Surgery is indicated only when all conservative measures have been tried without success, in patients with advanced osteoarthritis and severe subjective impairment from their symptoms *(Box 5)*.

BOX 5

Joint-preserving surgical treatment options

- Symptomatic
  - Lavage
  - Shaving
  - Debridement
- Bone-stimulating
  - Drilling
  - Microfracturing
  - Abrasion arthroplasty
- Joint surface restoration
  - Autologous chondrocyte transplantation (ACT)
  - Autologous osteochondral transplantation (OCT)
- Corrective osteotomy near the joint

Surgery

The overwhelming majority of intra-articular operations are performed through an arthroscope. The main advantages of arthroscopic procedures are minimal operative trauma and a very low infection rate (under 0.1%). Mosley et al. assessed the efficacy of arthroscopy in a randomized, placebo-controlled trial (evidence level I) (14). The patients in this trial were assigned to one of three groups:

Group 1: arthroscopic debridement

Group 2: arthroscopic lavage

Group 3: placebo group with a skin incision only.

24 months after the procedure, the results in groups 1 and 2 were not significantly better than those in group 3. It was pointed out that the findings do not give any indication of the role of placebo effects in surgical outcome, or whether other, independent effects are at work.

Arthroscopic lavage was described as early as 1934 by Burmann (15). The purpose of this technique is to rid the joint of detritus and inflammatory mediators. Its probability of success as an individual procedure cannot be judged, because it is usually performed today concomitantly with other intra-articular maneuvers in the same operative sitting.

Shaving, also called chondroplasty, involves removing frayed and fragmented cartilage (Outerbridge stages 2 and 3) and smoothing the edges (16). This technique, too, has been found to yield no more than a short-term benefit.

Debridement, described in 1941 by Magnuson (17) as "house-cleaning arthroplasty," serves the same general purposes. It is also useful for the treatment of possible meniscal damage, the removal of free-floating bodies within the joint, and the reduction of symptomatic osteophytes.

The goal of bone-stimulating techniques is to open the subchondral cartilage and thereby bring pluripotential stem cells to the joint surface, where they are then supposed to form fiber bundles under the influence of mechanical and biological forces. Studies have not revealed any significant differences between the various methods that are used (18).

Autologous chondrocyte transplantation was described in 1984 by Brittberg. In this technique, cartilage cells are taken from the joint, enzymatically isolated and cultured ex vivo, and then put back into the joint at the site of the cartilage defect, which is prepared ("freshened up") before the cultured cells are added (19). Long-term results are not yet available to document the survival of the reimplanted cartilage cells (20).

In autologous osteochondral transplantation (OCT), also called mosaicplasty, cylinders of cartilage and bone are taken from a part of the joint that is not affected, and then inserted into the cartilage defect with press-fit technology. In principle, OCT can be performed through an arthroscope, unless the defect is too large (21). An important finding is that fibrocartilage is macroscopically demonstrable at the interface between the osteochondral cylinder and the native local tissue; thus, solid integration is not present (22). The reported results of OCT are, in general, very promising. For example, the rate of good or very good outcomes was 92% in a prospective clinical trial performed by Hangody et al. (evidence level II) (23). 81 of the 98 follow-up arthroscopies that were performed revealed congruent surfaces as well as the histologically verified survival of the transplanted osteochondral cylinders.

Corrective osteotomy near the knee joint can be performed in the frontal, sagittal, or transverse plane, in

Symptomatic, joint-preserving surgical techniques

– Lavage
– Shaving
– Debridement

Bone-stimulating surgical techniques

– Drilling
– Microfracturing
– Abrasion arthroplasty

either the distal portion of the femur or the proximal portion of the tibia (i.e., just above or just below the knee). The goal of such operations is to "tip" the affected portion of the joint out of the zone of excessive mechanical stress, redirecting the weight-bearing axis toward the portion of the joint that is still largely intact. Procedures can be classified as either subtractive (tending to narrow the joint) or additive (tending to widen it). The upper limit for additive correction is 8°, according to Jakob (24). If a stronger correction is needed, a subtractive procedure is advised. The indispensable elements of all such operations are a correct determination of the indication for surgery and optimal planning of the procedure to prevent primary over- or undercorrection. The reported results are, in general, good over the intermediate to long term (25). Corrective osteotomy is said to provide the benefit of making the patient able to participate in sports again, though there have been cases in which the correction was lost in further postoperative follow-up (e28). In 2007, a Cochrane Review of 13 randomized controlled trials documented significantly improved knee function and reduced pain. There has not been any study to date, however, in which corrective osteotomy near the knee joint is compared to conservative treatment (e29).

Overview

There are many treatments for knee osteoarthritis. Prevention is important: If the influences that can potentially damage the knee are eliminated early enough, then the development of osteoarthritis can be prevented, or at least the progression of any changes that are already present can be slowed. Patient education and counseling are the first step in any treatment plan and should include information about the course of the disease and the range of treatment options. A stepwise treatment algorithm should be applied, in order to slow the progression of the disorder and thereby grant the patient the best possible quality of life. Even though, for many forms of treatment, the clinical trials performed to date have shown only limited efficacy, this does not imply that these treatments should be abandoned. The best treatment for each patient should be chosen after an individual assessment of the severity of knee osteoarthritis and an individual evaluation of the risks. An important general principle is that surgery should be performed only when conservative treatment has failed.

Conflict of interest statement
The authors declare that no conflict of interest exists according to the guidelines of the International Committee of Medical Journal Editors.

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Methods of restoring the joint surface

– Autologous chondrocyte transplantation (ACT)
– Autologous osteochondral transplantation (OCT)

Overview

Prevention is important: If influences that damage the knee are eliminated, then osteoarthritis can be prevented, or else its progression can be slowed if it is already present.

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For e-references please refer to:
www.aerzteblatt-international.de/ref0910

A case report is available at:
www.aerzteblatt-internationel.de/article09m0152

Further information on CME

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The solutions to the following questions will be published in issue 17/2010.

The CME unit "Diabetic Retinopathy" (issue 5/2010) can be accessed until 19 March 2010.

For issue 13/2010 we plan to offer the topic "Child Abuse and Neglect: Diagnosis and Management."

Solutions to the CME questionnaire in issue 1–2/2010:
Loddenkemper R, Hauner B: Drug Resistant Tuberculosis. Solutions: 1e, 2c, 3a, 4e, 5e, 6e, 7a, 8a, 9a, 10a

Please answer the following questions to participate in our certified Continuing Medical Education program. Only one answer is possible per question. Please select the answer that is most appropriate.

Question 1

Which of the following is a significant exogenous risk factor for the development of osteoarthritis?

a) Post-menopausal changes
b) Sports
c) Underweight
d) Depression
e) Macrotrauma

Question 2

Which of the following is a common complaint of patients with osteoarthritis?

a) Sensitivity to heat
b) Shock-like pain
c) Infection with positive cultures
d) Pain on the initiation of movement of a joint
e) Onset of symptoms in adolescence

Question 3

What radiological finding is characteristic of Stage 4 osteoarthritis?

a) Beginning osteophyte formation
b) Moderate joint space up to 50%
c) Joint destruction
d) Joint space narrowing less than 50%
e) Increased transparency

Question 4

What should be the first goal of treatment for osteoarthritis of the knee, according to the guidelines?

a) Delaying progression
b) Improving walking ability
c) Improving joint motility
d) Pain relief
e) Improving the patient's quality of life

Question 5

What is the main benefit of orthopedic aids in the treatment of osteoarthritis of the knee?

a) Taking mechanical stress off the joint
b) Ridding the joint of debris
c) Muscle buildup
d) Regression of osteoarthritis
e) Preparation for surgery

Question 6

Which of the following methods of treating osteoarthritis of the knee has been shown to be beneficial at evidence level Ib?

a) Arthroscopic lavage
b) Electrical stimulation
c) Arthroscopic shaving
d) Magnetic resonance therapy
e) Orthosis

Question 7

What is the therapeutic purpose of chondroplasty?

a) Removing frayed cartilage and smoothing the edges
b) Transplantation of cartilage cells
c) Injection of hyaluronic acid
d) Repositioning of the joint axis
e) Transplantation of cartilage-bone cylinders

Question 8

In which of the following locations can a corrective osteotomy near the knee joint be performed?

a) Proximal tibial
b) Distal tibial
c) Proximal femoral
d) Diaphyseal femoral
e) Diaphyseal tibial

Question 9

What is the main therapeutic purpose of corrective osteotomy?

a) Regression of osteoarthritis
b) Repositioning of the line of weight-bearing
c) Building up cartilage
d) Smoothing out the defective cartilaginous surface
e) Restricting movement

Question 10

According to the EULAR treatment algorithm, what is the agent of first choice in the treatment of osteoarthritis, which should be given over the long term, if it is effective?

a) Paracetamol
b) Tramadol
c) Corticosteroids
d) Acetylsalicylic acid
e) Indomethacin

CONTINUING MEDICAL EDUCATION

The Epidemiology, Etiology, Diagnosis, and Treatment of Osteoarthritis of the Knee

Joern W.-P. Michael, Klaus U. Schlüter-Brust, Peer Eysel

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CONTINUING MEDICAL EDUCATION

The Epidemiology, Etiology, Diagnosis, and Treatment of Osteoarthritis of the Knee

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Figure 1
Radial tear of the medial meniscus

Figure 2
Medial cartilaginous damage of the tibia, stage 4

Figure 3
Microfracturing of the medial tibial plateau and partial resection of the medial meniscus

Case

An otherwise healthy and well-nourished 42-year-old woman came to us for a consultation. She had sustained torsional injury to her right knee from a fall at age 18. In 1987, because of lateralization of the patella, she had undergone a tuberosity transfer procedure on the right knee. A total of three arthroscopic procedures had been performed because of medial meniscal damage in the right knee. She had been asymptomatic for a long time thereafter, but then presented to us again because she had been suffering for six months from very severe pain related to weight-bearing on the right knee, localized to the medial compartment of the knee. She could walk for only 15 minutes without crutches. On clinical examination, the most prominent finding was tenderness over the medial joint space, with a medial meniscus sign. The right knee joint was freely mobile, with stable ligaments. Further findings included a joint effusion of considerable size and mild retropatellar crepitations. The x-rays (knee in two planes, axial patellar view and whole-leg radiograph) showed osteoarthritis of the knee, more severe on the medial side, with narrowing of the joint space and osteophyte formation, a well-centered patella, and mild valgus deviation of the axis. Knee arthroscopy revealed an area of stage 4 cartilaginous damage in the anteromedial tibial plateau measuring 5 x 5 mm, as well as a radial tear of the medial meniscus *(Figures 1 and 2)*.

The medial meniscus was partially resected, and microfracturing of the medial tibial plateau was performed *(Figure 3)*. After six weeks of partial weight-bearing (15 kg), the patient was fully mobilized and was asymptomatic for months thereafter.

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